

ANSWERS TO ODD-NUMBERED PROBLEMS

Chapter 1

- 1.1 a) 1.61 km b) 3.28×10^3 ft
 1.3 1.02 ns
 1.5 5.36 L
 1.7 31.7 y
 1.9 a) 23.4 km/L b) 1.42 tanks
 1.11 9.0 cm
 1.13 a) $1.1 \times 10^{-3}\%$ b) no
 1.15 a) 0.1% b) 0.008% c) 0.03%
 1.17 a) 2.8 ± 0.3 cm³ b) 170 ± 20
 1.19 a) no b) no c) no d) no e) no
 1.21 10^6
 1.23 10^9
 1.25 \$70 million
 1.29 $\$9 \times 10^{14}$; about $\$3 \times 10^6$
 1.31 7.8 km, 38° north of east
 1.33 144 m, 41° south of west
 1.35 $A_x = 0$, $A_y = -8.00$ m; $B_x = 7.50$ m, $B_y = 13.0$ m; $C_x = -10.9$ m, $C_y = -5.07$ m; $D_x = -7.99$ m, $D_y = 6.02$ m
 1.37 1190 N; 13.4° above forward direction
 1.39 a) 9.01 m, 33.7° b) 9.01 m, 33.7°
 c) 22.3 m, 250.3° d) 22.3 m, 70.3°
 1.41 5.06 km, 20.2° north of west
 1.43 a) 2.48 cm, 18.3° b) 4.10 cm, 83.7°
 c) 4.10 cm, 263.7°
 1.45 781 N, 166°
 1.47 $\vec{A} = -(8.00 \text{ m})\hat{j}$; $\vec{B} = (7.50 \text{ m})\hat{i} + (13.0 \text{ m})\hat{j}$;
 $\vec{C} = -(10.9 \text{ m})\hat{i} + (-5.07 \text{ m})\hat{j}$;
 $\vec{D} = (-7.99 \text{ m})\hat{i} + (6.02 \text{ m})\hat{j}$
 1.49 a) $\vec{A} = (1.23 \text{ m})\hat{i} + (3.38 \text{ m})\hat{j}$;
 $\vec{B} = (-2.08 \text{ m})\hat{i} + (-1.20 \text{ m})\hat{j}$;
 $\vec{C} = (12.01 \text{ m})\hat{i} + (14.94 \text{ m})\hat{j}$
 c) 19.17 m; 51.2°
 1.51 a) no b) no; yes c) ± 0.20
 1.53 a) -104 m^2 b) -148 m^2 c) 40.6 m^2
 1.55 a) 165° b) 28° c) 90°
 1.57 a) 63.9 m^2 ; $-\hat{k}$ b) 63.9 m^2 ; $+\hat{k}$
 1.59 a) 4.61 cm^2 ; $-\hat{z}$ b) 4.61 cm^2 ; $+\hat{z}$
 1.61 a) 1.65×10^4 km b) 2.6 earth radii
 1.63 10^{28}
 1.65 a) 2.94 cm b) 1.82 cm
 1.67 a) 10^{50} b) 10^{57} c) 10^{79}
 1.69 149 N; 32.2° north of east
 1.71 b) $A_x = 3.03$ cm, $A_y = 8.10$ cm c) 8.65 cm;
 69.5° from the +x-axis toward the +y-axis
 1.73 144 m, 41° south of west
 1.75 a) 46 N, 139°
 1.77 a) (87, 258) b) 136 pixels, 25° below
 straight left
 1.79 380 km, 28.8° south of east
 1.81 160 N, 13° below horizontal
 1.83 a) 911 m; 8.9° west of south
 1.87 b) 90°
 1.89 a) $A = 5.39$, $B = 4.36$
 b) $-5.00\hat{i} + 2.00\hat{j} + 7.00\hat{k}$ c) 8.83; yes
 1.93 a) 54.7° b) 35.3°
 1.95 $C_x = 8.0$, $C_y = 6.1$
 1.97 b) 72.2
 1.99 38.5 yd, 24.6° to right of downfield
 1.101 a) 76 ly b) 129°

Chapter 2

- 2.1 a) 197 m/s b) 169 m/s
 2.3 1 h 10 min
 2.5 a) 17.1 s b) faster: 106 m; slower: 94 m
 2.7 250 km
 2.9 a) 12.0 m/s b) 0 m/s, 15.0 m/s, 12.0 m/s
 c) 13.3 s
 2.11 a) 2.3 m/s, 2.3 m/s b) 2.3 m/s, 0.33 m/s
 2.13 a) no b) (i) 12.8 m/s² (ii) 3.5 m/s²
 (iii) 0.72 m/s²; yes
 2.15 a) 2.00 cm/s, 50.0 cm, -0.125 cm/s^2
 b) 16.0 s c) 32.0 s d) 6.20 s, 1.22 cm/s;
 25.8 s, -1.22 cm/s ; 36.4 s, -2.55 cm/s

- 2.17 a) 3 m/s² b) 10 m/s² c) depends on
 positive coordinate direction
 2.21 a) 5.0 m/s b) 1.43 m/s²
 2.23 a) 675 m/s² b) 0.067 s
 2.25 1.70 m
 2.27 a) (i) 5.59 m/s² (ii) 7.74 m/s²
 b) (i) 179 m (ii) 12,800 m
 2.29 a) $+2.7 \text{ cm/s}$, -1.3 cm/s^2 b) -1.3 cm/s^2
 c) 22.5 cm; 25.5 cm
 2.31 a) 0, 6.3 m/s², -11.2 m/s^2
 b) 100 m, 230 m, 320 m
 2.33 a) $1.80 \times 10^4 \text{ m/s}$ b) 0.957
 c) 6 h 11 min
 2.35 b) 1 s, 3 s d) 2 s e) 3 s f) 1 s
 2.37 a) A : 20.5 m/s²; B : 3.8 m/s²; C : 53 m/s²
 b) 721 km
 2.39 a) 2.94 m/s b) 0.599 s
 2.41 a) $t = \sqrt{2d/g}$ b) 0.190 s
 2.43 a) 646 m b) 16.4 s, 112 m/s
 2.45 a) 25.6 m/s b) 31.6 m c) 15.2 m/s
 2.47 a) 249 m/s² b) 25.4 c) 101 m d) no
 2.49 0.0868 m/s²
 2.51 a) $x(t) = (0.250 \text{ m/s}^3)t^3 - (0.0100 \text{ m/s}^4)t^4$;
 $v_x(t) = (0.750 \text{ m/s}^3)t^2 - (0.0400 \text{ m/s}^4)t^3$
 b) 39.1 m/s
 2.53 a) 30.0 cm/s
 2.55 b) 0.627 s, 1.60 s c) negative at 0.627 s,
 positive at 1.60 s d) 1.11 s e) 2.45 m
 f) 2.00 s, 0 s
 2.57 a) 82 km/h b) 31 km/h
 2.59 a) 3.5 m/s² b) 0 c) 1.5 m/s²
 2.61 a) 92.0 m b) 92.0 m
 2.63 a) 464 m/s b) $2.99 \times 10^4 \text{ m/s}$ c) 7.48
 2.65 50.0 m
 2.67 4.6 m/s²
 2.69 a) 6.17 s b) 24.8 m
 c) $v_{\text{truck}} = 13.0 \text{ m/s}$, $v_{\text{auto}} = 21.0 \text{ m/s}$
 2.71 a) 7.85 cm/s b) 5.00 cm/s, horizontal from
 the initial to final position
 2.73 a) 15.9 s b) 393 m c) 29.5 m/s
 2.75 a) -4.00 m/s b) 12.0 m/s
 2.77 a) 2.64H b) 2.64T
 2.79 a) no b) yes; 14.4 m/s; not physically
 attainable
 2.81 a) $6.79 \times 10^4 \text{ g}$ b) 1.45 m/s c) $H/4$
 2.83 a) 7.59 m/s b) 5.14 m c) 1.60 s
 2.85 a) 7.7 m/s b) 0.78 s c) 0.59 s d) 1.3 m
 2.87 270 m
 2.89 a) 20.5 m/s b) yes
 2.91 a) 947 m b) 393 m
 2.93 a) A b) 2.27 s, 5.73 s c) 1.00 s, 4.33 s
 d) 2.67 s
 2.95 a) 9.55 s, 47.8 m b) 1.62 m/s d) 8.38 m/s
 e) no f) 3.69 m/s, 21.7 s, 80.0 m
 2.97 a) 8.18 m/s b) (i) 0.411 m (ii) 1.15 km
 c) 9.80 m/s d) 4.90 m/s

Chapter 3

- 3.1 a) $v_{\text{av-x}} = 1.4 \text{ m/s}$, $v_{\text{av-y}} = -1.3 \text{ m/s}$
 b) 1.9 m/s, -43°
 3.3 a) 7.1 cm/s, 45° b) 5.0 cm/s, 90° ; 7.1 cm/s;
 45° ; 11 cm/s, 27°
 3.5 b) $a_{\text{av-x}} = -8.67 \text{ m/s}^2$, $a_{\text{av-y}} = -2.33 \text{ m/s}^2$
 c) 8.98 m/s², 195°
 3.7 b) $\vec{v} = a\hat{i} + (-2t)\hat{j}$; $\vec{a} = -2\beta\hat{j}$
 c) $v = 5.4 \text{ m/s}$, -63° ; $a = 2.4 \text{ m/s}^2$, -90°
 d) speeding up and turning right
 3.9 a) 0.600 m b) 0.385 m c) $v_x = 1.10 \text{ m/s}$,
 $v_y = -3.43 \text{ m/s}$; $v = 3.60 \text{ m/s}$, 72.2° below
 the horizontal
 3.11 3.32 m
 3.13 a) 30.6 m/s b) 36.3 m/s
 3.15 1.29 m/s²
 3.17 a) 40.0 m/s, 69.3 m/s b) 7.07 s c) 245 m
 d) 565 m e) $a_x = 0$, $a_y = -9.80 \text{ m/s}^2$;
 $v_x = 40.0 \text{ m/s}$, $v_y = 0$

- 3.19 a) 0.682 s, 2.99 s b) 24.0 m/s, 11.3 m/s;
 24.0 m/s, -11.3 m/s c) 30.0 m/s, -36.9°
 3.21 a) 1.5 m b) -0.89 m/s
 3.23 a) 13.6 m b) 34.6 m/s c) 103 m
 3.25 a) 296 m b) 176 m c) 198 m
 (i) horizontal: 15 m/s; vertical: 58.8 m/s
 (ii) horizontal: 15 m/s; vertical: 78.8 m/s
 3.27 795 m
 3.29 a) 0.034 m/s², 0.0034g b) 1.4 h
 3.31 a) 3.07 s b) 1.68 s
 3.33 a) 3.50 m/s², upward b) 3.50 m/s²,
 downward c) 12.6 s
 3.35 a) 32.9 m/s b) 27.7 m/s² c) 35.5 rpm
 3.37 a) 14 s b) 70 s
 3.39 0.36 m/s, 38° west of south
 3.41 a) 4.7 m/s, 25° south of east b) 190 s
 c) 380 m
 3.43 b) -7.1 m/s , -42 m/s c) 43 m/s, 9.5° west
 of south
 3.45 a) $A = 0$, $B = 2.00 \text{ m/s}^2$, $C = 50.0 \text{ m}$,
 $D = 0.50 \text{ m/s}^3$ b) $\vec{a} = (4.00 \text{ m/s}^2)\hat{i}$, $v = 0$
 c) $v_x = 40.0 \text{ m/s}$, $v_y = 150 \text{ m/s}$, $v = 155 \text{ m/s}$
 c) $\vec{r} = (200 \text{ m})\hat{i} + (550 \text{ m})\hat{j}$
 3.47 a) 124 m b) 280 m
 3.49 22 m/s
 3.51 40 m/s
 3.53 274 m
 3.55 a) 42.8 m/s b) 42.0 m
 3.57 a) $\sqrt{2gh}$ b) 30.0° c) 6.93h
 3.59 c) less than 45°
 3.61 b) 15° , 75°
 3.63 a) 17.8 m/s b) in river, 28.4 m from the near
 bank
 3.65 a) 81.6 m b) in cart c) 245 m d) 53.1°
 3.67 a) 49 m/s b) 50 m
 3.69 a) 2000 m b) 2180 m
 3.71 a) 38.5 m/s b) (i) 25.0 m/s, 0
 (ii) 25.0 m/s, 38.5 m/s c) (i) 0°
 (ii) 57.0° d) 499 m
 3.73 $\pm 25.4^\circ$
 3.77 b) $v_x = R\omega(1 - \cos\omega t)$, $v_y = R\omega\sin\omega t$,
 $a_x = R\omega^2\sin\omega t$, $a_y = R\omega^2\cos\omega t$ c) $t = 0$,
 $2\pi/\omega$, $4\pi/\omega$, ...; $x = 0$, $2\pi R$, $4\pi R$, ...;
 $y = 0$; $a = R\omega^2$ in the +y direction d) no
 3.79 a) 2.50g b) 0.614n
 3.81 a) 44.7 km/h, 26.6° west of south
 b) 10.5° north of west
 3.83 a) 0.659 s b) (i) 9.10 m/s (ii) 6.46 m/s
 c) 3.00 m, 2.13 m
 3.85 7.39 m/s, 12.4° north of east
 3.87 a) 80 m b) 1.6×10^{-3} c) overall effect is
 to reduce radius
 3.89 a) $\left(\frac{2v_0^2}{g}\right)[\tan(\theta + \phi) - \tan\theta] \frac{\cos^2(\theta + \phi)}{\cos\theta}$
 b) $\frac{\pi}{4} - \frac{\theta}{2}$
 3.91 $\Delta t = 0.5$ s; 9.589 m/s², 118.6° ; $\Delta t = 0.1$ s;
 9.983 m/s², 95.73° ; $\Delta t = 0.05$ s; 9.996 m/s²,
 92.86°
 3.93 a) 1.5 km/h b) 3.5 km/h

Chapter 4

- 4.1 a) 0° b) 90° c) 180°
 4.3 7.1 N to the right, 7.1 N downward
 4.5 494 N, 31.7°
 4.7 2.2 m/s²
 4.9 16.0 kg
 4.11 a) 3.13 m, 3.13 m/s b) 21.9 m, 6.25 m/s
 4.13 a) 45.0 N; $t = 2$ s to 4 s b) 2 s to 4 s
 c) 0, 6 s
 4.15 a) $A = 100$ N, $B = 12.5 \text{ N/s}^2$ b) (i) 21.6 N,
 2.70 m/s² (ii) 134 N, 16.8 m/s²
 c) 26.6 m/s²
 4.17 2.94×10^3 N
 4.19 a) 4.49 kg b) 4.49 kg, 8.13 N
 4.21 825 N, blocks